Technological Change and Employment of Older Workers

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Italo Gutierrez, *RAND*
Daniela Hochfellner, *NYU CUSP*
Nicole Maestas, *Harvard University*

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Motivation

New technologies in workplaces require changes in workforce skills, which can result in depreciation of human capital if it is not paired with training or continued education

Older workers are generally less likely to participate in training or education activities, which puts their skills at an increased risk of obsolescence

Not much is known how technological change affects wage growth, employment status and labor market exit among older workers

Prior Research

Effect of technological change on older workers' employment outcomes (Germany, Norway, France)

- Findings: technological change negatively affects the share of older workers on wage bills and reduces the proportion of older workers in the workplace

Other studies combine technological change and training

- Findings: training helps to reduce these negative effects

Limitation of these studies

- Short panels or cross-sectional studies.
- Either based on workers or firms, not both, but this is important to understand heterogeneity
- Only one technological change measure: investments in ICT

Our Contribution

We use two measures of technological change:

- Investment in ICT
- Innovation/improvements of products or services.

We use longitudinal linked employer-employee data

- We cover a longer (and more recent) period, from mid-1990s until 2010.
- We can study the effect of technological change on older workers' employment outcomes, using *firm surveys* & employee surveys.

Rich Administrative Data supplemented with Surveys

Information on workers and establishments matched on a specific reference date for the years 1993 to 2010

- Workers: type of employment, exact start and end dates, wages, professional and occupational status, and white-collar versus blue collar job, full-time versus part-time, sex, *birth year,* nationality, and education
- Establishments: start date, closure date, industry and location, information on technological change (*survey*), training of the workforce (*survey*).

We end up with in between 6,328 and 10,538 establishments per year for the period of 1996-2010 and observe between 1,890,805 and 2,521,786 workers per year in the mentioned time period.

Two Main Measures of Technological Change

- Investments in information and communication technologies (ICT).

- Index measure INNOVATION: equals 1 if establishment reports any of the following:
  - Improvement or further development of an existing product
  - Production/offering of products or services that already existed in the market
  - Production/offering of a completely new product that previously did not existed in the market

Outcomes: Job and worker flows

We look at the following outcomes:

- Hiring rate = Total hires / average employment
- Separation rate = Total separations/ average employment
- Churning rate = (Hires+Separations)/ average employment
- Net employment growth rate= (Hires-Separations)/ average employment

Outcomes separated by age group: young (20-34), prime-age (35-49), older workers (50-64)

Outcomes: Share of each age group in total employment and flows

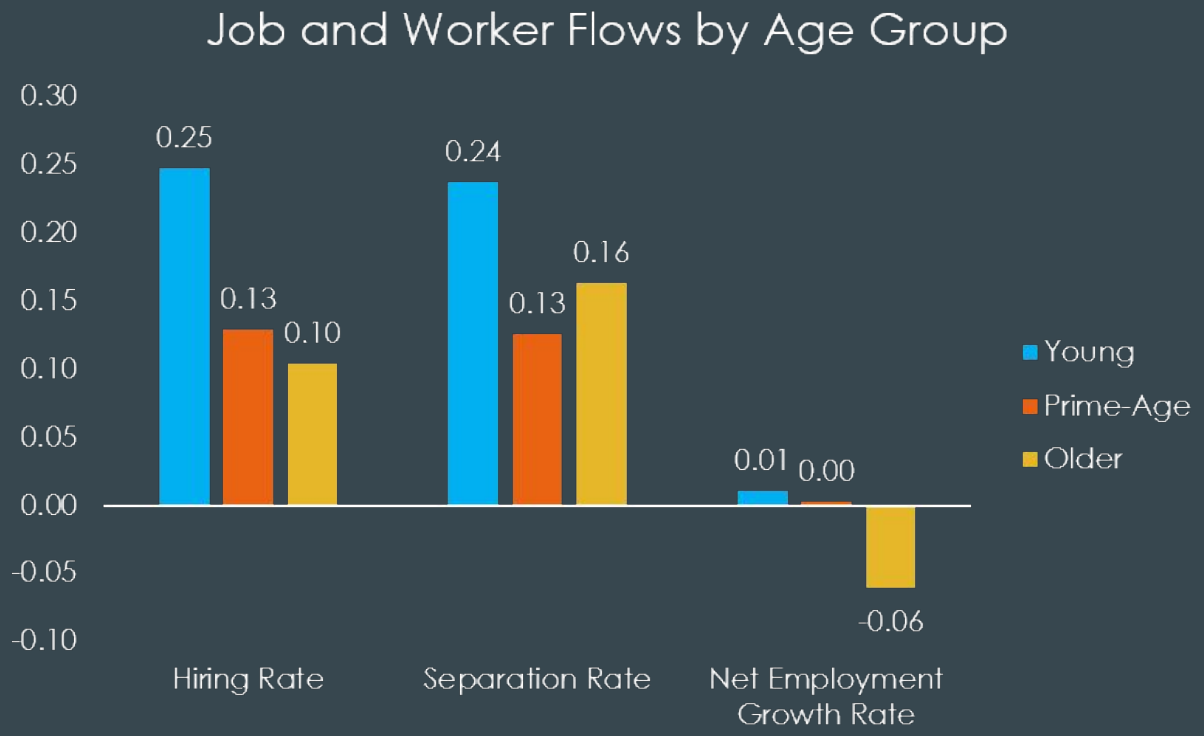
- Share of total employment: Total workers in age group A / Total Workers
- Share of all separations: Total separations in age group A / Total Separations
- Share of all hires: Total hires in age group A / Total Hires

Outcomes: Wages and wage bill share

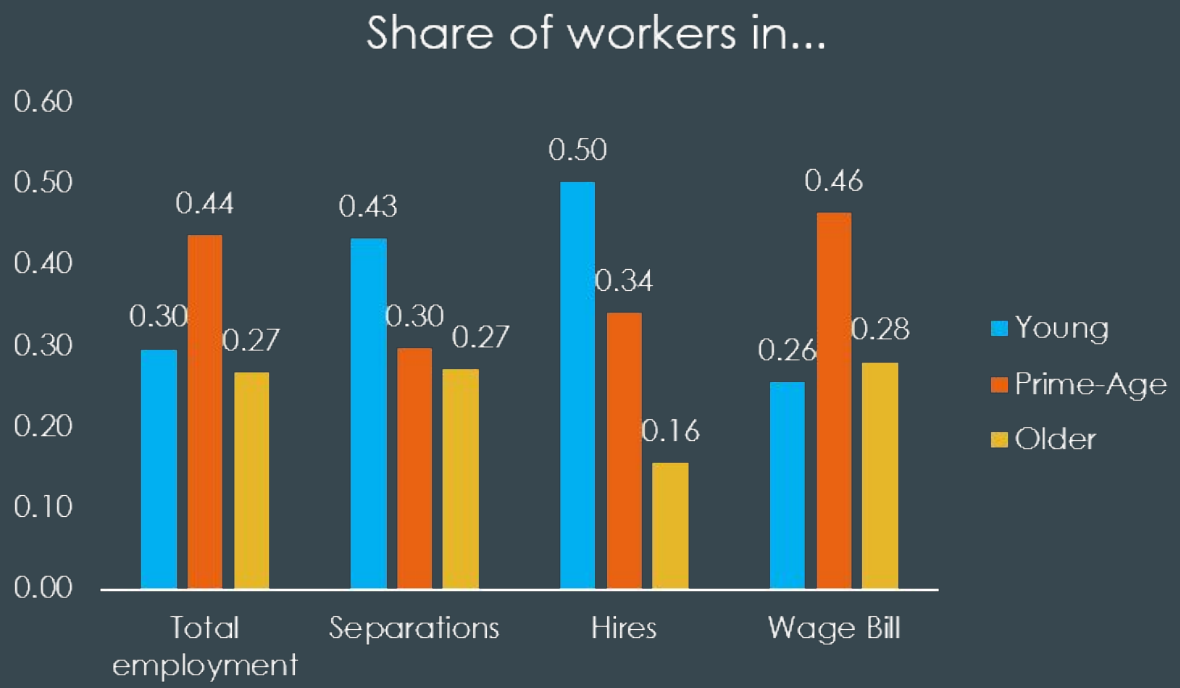
- Average wage of workers in each age group
- Share in the establishment's wage bill of each age group:

Total Labor Bill for age group A / Total Labor Bill

Sample Statistics



Sample Statistics

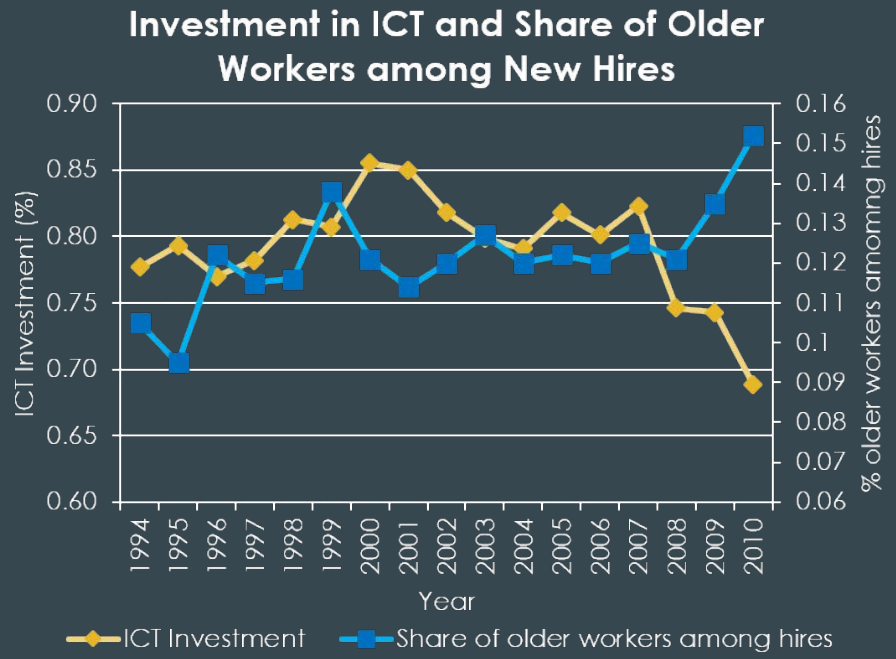


Sample Statistics

	Mean	Standard Deviation
ICT investment	0.61	0.49
Innovations:		
Improved or further developed a existing product?	0.48	0.50
Offered a new product/service that had been on the market before?	0.26	0.44
Offered a completely new product/service for which a new market had to be created?	0.13	0.34
Any innovation	0.52	0.50

Our Main Finding in a Nutshell

- In years establishments invest in ICT they are less likely to hire older workers.
- Also, older workers make up a smaller fraction of the new hires joining an establishment



Empirical Approach

$$y_{eat} = \alpha^{a}{}_{e} + \alpha^{a}{}_{t} + \alpha^{a}{}_{ICT}\, ICT_{et} + \alpha^{a}{}_{INNOVATION}\, INNOVATION_{et} + \alpha^{a}{}_{X} X_{et} + \epsilon_{et}$$

- *e*=establishment; *a*=age group; *t*=year (June-June)
- We ran a separate model for each outcome and age group.
- y_{eat} : outcome of interest for age group *a* in establishment *e* in year *t*
- ICT : measures any investment in any ICT
- INNOVATION : any development of new products or improvement of existing products.
- Standard errors are clustered at the establishment level.

Controls

- Establishment and year fixed effect
- Establishment size (10-49 employees; 50-499 employees and 500+ employees), Employment growth (less than -5%, from -5% to 0%, 0%, from 0% to 5% and more than 5%).
- The time the establishment has been in operation.
- Whether the establishment has obsolete or state of the art equipment
- Whether the establishment is going to close down in the next wave.
- The share of women in the establishment workforce.
- The share of workers in low, medium and high-skilled occupations.
- Whether the establishment is bounded by a wage agreement.
- Whether the establishment has a works council.
- Whether the establishment is introducing other organizational changes.

ICT and innovations reduce separation rates

Variable	Hiring Rate	Separation Rate	Churning Rate	Net Employment Growth Rate
All Workers				
ICT investment	-0.0022	-0.0036***	-0.0054***	0.0015
	(0.001)	(0.001)	(0.002)	(0.002)
Any innovation	0.0002	-0.0042***	-0.0039	0.0046**
	(0.002)	(0.002)	(0.002)	(0.002)

Effects are stronger for young workers, and associated with employment growth

Variable	Hiring Rate	Separation Rate	Churning Rate	Net Employment Growth Rate
Young Workers				
ICT investment	-0.0015	-0.0094***	-0.0092**	0.0084**
	(0.003)	(0.003)	(0.004)	(0.004)
Any innovation	0.0036	-0.0063**	-0.0017	0.0094**
	(0.003)	(0.003)	(0.005)	(0.004)

Weaker effects for prime-aged workers

Variable	Hiring Rate	Separation Rate	Churning Rate	Net Employment Growth Rate
Prime-Age Workers				
ICT investment	-0.0018	-0.0032*	-0.0042*	0.0004
	(0.002)	(0.002)	(0.003)	(0.003)
Any innovation	-0.0004	-0.0036*	-0.0044	0.004
	(0.002)	(0.002)	(0.003)	(0.003)

ICT does not affect separation rates of older workers, but decreases the hiring rate.

Variable	Hiring Rate	Separation Rate	Churning Rate	Net Employment Growth Rate
Older Workers				
ICT investment	-0.0059**	-0.004	-0.0094**	-0.0032
	(0.002)	(0.003)	(0.004)	(0.004)
Any innovation	0.0008	-0.0069**	-0.0053	0.006
	(0.003)	(0.003)	(0.004)	(0.004)

ICT related to favorable outcomes for younger workers: higher earnings and higher shares in employment and wage bill

Variable	Workforce Share	Share of Separa-tions	Share of Hires	Average Daily Wage	Relative Daily Wage (ref. young)	Relative Daily Wage (ref. pr-age)	Share of Wage Bill
ICT investment	0.0038***	0.0033	0.0029	0.5339***	n.a.	n.a.	0.0040***
	(0.001)	(0.003)	(0.003)	(0.158)	n.a.	n.a.	(0.001)
Any innovation	0.0014	0.002	0.0056*	0.2732	n.a.	n.a.	0.0012
	(0.001)	(0.003)	(0.003)	(0.207)	n.a.	n.a.	(0.001)

Not many significant results for prime-age workers

Variable	Workforce Share	Share of Separa-tions	Share of Hires	Average Daily Wage	Relative Daily Wage (ref. young)	Relative Daily Wage (ref. pr-age)	Share of Wage Bill
ICT investment	-0.0017*	-0.0023	0.002	-0.0118	n.a.	n.a.	-0.0016
	(0.001)	(0.003)	(0.003)	(0.105)	n.a.	n.a.	(0.001)
Any innovation	-0.0005	-0.0005	-0.0032	0.2239	n.a.	n.a.	0.0001
	(0.001)	(0.003)	(0.003)	(0.150)	n.a.	n.a.	(0.001)

ICT related to disadvantageous outcomes for older workers: less relative wage, less participation in employment, hires and wage bill

Variable	Workforce Share	Share of Separa-tions	Share of Hires	Average Daily Wage	Relative Daily Wage (ref. young)	Relative Daily Wage (ref. pr-age)	Share of Wage Bill
ICT investment	-0.0021***	-0.001	-0.0049**	0.0642	-0.0368*	-0.0051	-0.0024***
	(0.001)	(0.003)	(0.002)	(0.161)	0.0193	0.008	(0.001)
Any innovation	-0.0009	-0.0015	-0.0025	0.1867	-0.016	-0.0056	-0.0012
	(0.001)	(0.003)	(0.003)	(0.226)	0.0203	0.0084	(0.001)

Take Home Key Points

Investment in ICT has a negative effect on older workers employment outcomes, particularly on the hiring margin.

The strong dismissal procedures and seniority rules in the German labor market might explain why we do not see an effect of investments in ICT on separation rates.

We find negative effects of investments in ICT on older workers' relative earnings and participation in the wage bill.

Next steps

- Refine measures of investments in ICT using monetary values (available only for half of the sample)
- Try potential IV strategy based on national investments in ICT by industry (national accounts data; KLEMS project).
- Look at firms' reported measures on training assistance.
- Look at matched individual survey data (2006-2010) that contains information on individuals' reported technological changes, training episodes, employment, satisfaction and retirement expectations.

Backup slides

A note on measurement of outcomes

- Hiring rate:

$$H_{eat} = \frac{IN_{eat}}{[(E_{eat-1} + E_{eat})/2]} \quad \text{vs} \quad H_{eat} = \frac{IN_{eat}}{[(2 \times E_{eat-1} + IN_{ea} - OUT_{ea}/2]}$$

(*e*=establishment; *a*=age group; *t*=year (June-June)

- Separation rate:

$$S_{eat} = \frac{OUT_{eat}}{[(2 \times E_{eat-1} + IN_{ea} - OUT_{ea}/2]}$$

A note on measurement of outcomes

- Churning rate:

$$C_{eat} = \frac{IN_{eat} + OUT_{eat}}{[(2 \times E_{eat-1} + IN_{ea} - OU\,T_{ea}/2]}$$

- Net employment growth rate:

$$G_{eat} = \frac{IN_{eat} - OUT_{eat}}{[(2 \times E_{eat-1} + IN_{ea} - OU\,T_{ea}/2]}$$

- Share of total employment: $ShE_{eat} = \frac{E_{eat}}{\Sigma E_{eat}}$
- Share of all separations: $ShS_{ea} = \frac{OUT_{ea}}{\Sigma OUT_{ea}}$
- Share of all hires: $ShH_{ea} = \frac{IN_{ea}}{\Sigma IN_{ea}}$

Can the U.S. learn from Germany?

By 2035, the mean age of the population in the United States will be about the same as it was in Germany in the mid-2000s

Mean Population Age, Germany vs. U.S.